Bragg addressed the Geology Section on X-rays and crystal structure; I think this was as useful as a joint meeting with Section A would have been.

(2) I very much doubt the assumption commonly made that the application of science to life and industry is what the public want to hear about. It may be good for them to hear about it, but we shall have to gild the pill with more attractive subjects, such as the age of the earth, the excavations at Cnossus, the properties of prime numbers, or Einstein. The public that we are trying to reach may be interested in the application of X-rays to atomic structure, but a paper on the latest X-ray apparatus in the hospitals would be hopelessly dull. May we not draw a moral from the fact that the best-attended Section at Cardiff seems to have been that which devoted its whole programme to pure science and scarcely touched on any industrial applications? To lay stress on the valuable material *results* of science may be the best way of touching the pockets of commercial magnates, but the British Association has also the missionary task of encouraging interest in the *methods* of science and of spreading the true scientific spirit.

The question remains: Can anything be done to set forth in a more popular way the methods of science in the towns we visit? I think anything that is done must be outside our Sectional proceedings. To popularise them would merely result in the majority of professional scientific workers staying away, leaving only those interested in scientific propaganda. Although some of our ablest men of science have the gift of being able to deliver attractive popular lectures, the majority have no special aptitude or inclination for this, and there is no reason whatever why they should. If they have trained themselves to be able to explain their work lucidly to those who have been educated to understand and criticise, they have done their part, and may leave to others the work of propaganda. We must avoid the painful spectacle of a brilliant investigator placed in an unfamiliar position before a popular audience and trying to talk down to them—a task performed much better by a man with a tenth of his knowledge, but who has practised the art of popular lecturing. Moreover, the public wants his very latest conclusions, stated without the conditions and reservations which they do not understand; and when next year he alters his opinion in the light of further advances, they will deride him and men of science generally for advertising sensationally themselves and their half-baked conclusions. It is right that we should try to make some more direct return to the public in the towns the hospitality of which we enjoy; but the difficulties and dangers are so obvious that it is desirable to proceed very cautiously.

References to the good old days of the Association, when Kelvin, Maxwell, and others would argue by the blackboard and the audience could watch new discoveries emerging, produce in my mind an effect opposite to that apparently intended. It makes me realise how greatly the Association has advanced since then. In these days, too, we have a big X, Y, Z whose views on any subject under discussion would have delighted the audience, and their presence and happy way of saying the right thing or putting an encouraging question when it was needed cannot be too highly valued. But more often X shook his head, and a whisper from the Recorder reminded me that X (a name scarcely known to the majority present) had made a life-study of the particular problem, and it was he who enlightened us. The great democracy of scientific workers is a product of the newer age, and nowhere does one feel that sense of equality and fraternity so convincingly as at the British Association.

A. S. EDDINGTON.

WITH reference to the views expressed by correspondents in NATURE as to the future of the British Association, based, it would seem, in large measure on the rather disappointing attendance at the recent meeting at Cardiff, it appears to me there were reasons for this irrespective of any decadence of the Association. May not the date being so near the height of the holiday season—viz. the end of August rather than the beginning of September, as on so many previous occasions—be accountable for the absence of some members? In these times there are more counter-attractions than formerly for scientific workers and others interested in scientific or professional subjects in connection with their own special annual gatherings. Having yielded to the claims of these, they cannot afford the time or expense of attending the British Association meeting in addition. For example, a friend of mine residing in South Wales, whom I hoped to meet at Cardiff, expressed his regret at not being able to be present, as he had to expend all his spare time during the first two weeks in August at the national Eisteddfod of Wales at Barry and the annual meeting of the Welsh Bibliographical Society also held there, and at the Cambrian Archæological Association meeting in Gower. In some instances the increased railway fares (and no reduction as formerly) and hotel and other expenses acted as deterrents, and not any falling off of interest in the Association that kept many away. The bulk of the usual attenders at the British Association belong to the class who have been most severely hit by the present hard times.

WILSON L. FOX.

Carmino, Falmouth, October 5.

Recapitulation and Descent.

THE passage entitled "Recapitulation as Proof of Descent" in Dr. Bather's "Fossils and Life" (see NATURE for September 30, p. 162) calls for critical comment, inasmuch as it is representative of inconsequent reasoning current in several text-books commonly in use among students.

If experimental breeding justified the inference that a mutant form should recapitulate the characters of its ancestral stock, the observed fact that developmental stages in the life of an organism frequently resemble adult forms which are antecedent to it in the time process would constitute a cogent consideration for regarding these antecedent forms as ancestral to such an organism. But genetic investigation does not at present lead to such a prediction, and hence it is perfectly evident that recapitulatory phenomena do not provide direct evidence for evolution. Hitherto experiment has not thrown any light on the genetic significance of recapitulation, except so far as to suggest that factorial elimination rather than any "perennial desire of youth to attain a semblance of maturity" (whatever this may mean) is the key to "the omission of some steps in the orderly process."

As Sedgwick many years ago emphasised, for the purpose of the general theory of evolution recapitulatory phenomena are of interest only as extending the law of unity of type; while the value of embryological data for phylogenetic speculations resides logically in the fact that the embryologist studies the entire sequence of structural arrangements which characterise a living organism, whereas the comparative anatomist of adult life pays attention to only one of them.

It is easy to appreciate that in a generation which was obsessed with the "immutability of species" recapitulatory phenomena would greatly influence the minds of persons otherwise slow to recognise the varying degree of similarity and dissimilarity in the

© 1920 Nature Publishing Group

combination of genetic characters which living forms exhibit; the palæontologist shows that these varying degrees of similarity and dissimilarity have been brought about by progressive differentiation in both time and place; but, as Dr. Bather rightly insists, succession (progressive differentiation) does not of necessity imply descent. The final step in the argument for evolution (*i.e.* the theory that progressive differentiation has been effected through the agency of the process of reproduction) is that organisms are known to be derived only from pre-existing organisms, and that new genetic characters are from time to time differentiated in the actual course of normal generation; hence to interpret the diversity of genetic characters in living forms *in terms of experience* it can only be inferred that such diversity has been brought about in the course of descent.

It appears to me that the paramount necessity for clear statement on the logical position of the evolution theory is: (1) To recognise that much of the reasoning employed in the past originated in the emotional atmosphere created by popular prejudice and hostility; and (2) while appreciating the fact of specificity (genetic stability), to dispense entirely with the arbitrary notions connected with the term "species" as employed by systematists. It is interesting to note in conclusion that Darwin himself regarded the facts of ontogeny as an extension of the law of unity of type rather than a contention *sui generis* in favour of the theory of evolution.

LANCELOT T. HOGBEN.

Imperial College of Science,
South Kensington, S.W.7, October 2.

I AM much obliged to you for letting me see Mr. Hogben's most interesting letter, and I thank him for emphasising the fact that the mutants of the experimental breeder do not show such recapitulatory phenomena as do the mutations of the palæontologist. Since this point was dealt with, however imperfectly, in the address, I surmise that Mr. Hogben has considered only the extract published in NATURE. His statement of "the final step in the argument for evolution" appears to me consequent, but I am not yet prepared to admit that my statement was inconsequent. Neither, I fear, is absolutely conclusive. Consequent or inconsequent, I did my best to view the problem without prejudice or emotion, but I plead guilty to some attempt at humour.

F. A. BATHER.

A Fracture-surface in Igneous Rock.

THE accompanying photograph (Fig. 1) was taken by me some years ago during the construction of the Shirawta Dam, Bombay Hydro-Electric Works, India. It shows a curious fracture surface due to a heavy gelignite detonation in finely crystalline "trap" rock. So far as I can remember, I had seen other examples of this phenomenon, but photographed this as it was a particularly good one, and I thought it would be of special interest to "elasticians."

B shows the "splash effect," having its origin at the bottom of the 1½-in. diameter vertical drill-hole A. C is a two-foot rule used to fix the scale. E is the vertical edge of a fault (or possibly a dyke) in the "trap" rock. D points to one of the faint radial "splash" lines that form a sort of aurora about the explosion centre A.

It will be noticed that the "splash" at B looks like the fluting of a large fossil. The Deccan "trap," however, is an igneous rock, and, of course, has no fossils in it. Tentative explanations that may be advanced are (*a*) that the pressure at A was so enormous at the moment of detonation that an actual flow of the rock took place; (*b*) that the fluted surface is the result of unequal stress distribution due to "interference" between waves reflected from the three reflecting surfaces. These surfaces are: (1) The rock surface some 10 ft. to 20 ft. above and parallel to the foot-rule C. (2) The face of the fault E. (3) The original face of the cutting lying in a plane parallel to the plane of the paper and, at the most, 2 ft. in a line normal to the paper from the points A and B.

The distance to the original face before the blast would not be more than 6 in. to 1 ft. from the top of the drill-hole shown. The hole was drilled in the side of the rock cutting having a "batter" of about one in five, at the stage when the photograph was taken. The drill-hole A would probably be about 3½ ft. deep, and the point A about 5 ft. above the floor of the cutting.

It should also be mentioned that the site of this explosion was the side of a rock cutting about half a mile long, with level bottom leading to the Shirawta-Walwhan tunnel. The rock cut at the shallow end would be about 3 ft. deep, and at the tunnel end about 40 ft.; its top width was 20 ft., and its width at the bottom was, at that date, from 5 ft. to 10 ft.

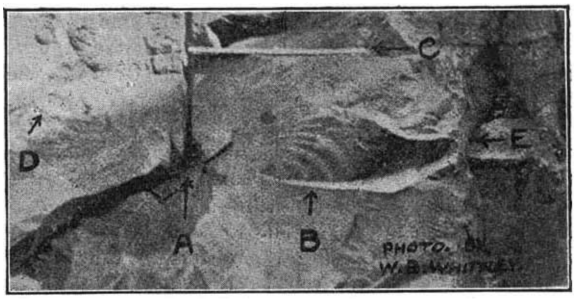

FIG. 1.—Splash-like fracture-surface due to gelignite explosion in rock A, base of 1½" diameter drill-hole and origin of explosion; B, fluted "splash effect"; C, 2-ft. rule, to fix scale; D, one of a number of radial "splash' lines.

Samples of rock similar to that blown away from A were weighed, and their specific gravity worked out at between 2·720 and 2·752 (taking the weight of a cubic foot of water as 62·5 lb.).

(Prof. B. Hopkinson calculated that the maximum pressure at the face of an explosion of 1 oz. of guncotton is of the order 100 tons per sq. in., and that this maximum is attained in 1/400,000th of a second.)

Since writing the above, it has been suggested that the phenomenon is a large example of conchoidal fracture. In any case, I think the photograph will be of interest to readers of NATURE.

W. BEVAN WHITNEY.

Meadow House, Layters Way,
Gerrards Cross, Bucks, September 19.

A Visual Illusion.

THE visual illusion described by Mr. Turner in NATURE of October 7, p. 180, may be seen very well by looking steadfastly at a long luggage train as in, for example, counting the trucks at about 100 yards distance. Immediately after the train has passed, the embankment appears to slide along in the opposite direction.

A. E. BOYCOTT.

17 Loom Lane, Radlett, October 10.

© 1920 Nature Publishing Group